Gravity Monitoring of Ground-Water Storage Change in Central and Southern Arizona

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Repeat observations of the absolute acceleration of gravity have routinely been made at several stations in central and southern Arizona since 1998. The observations are gravity control for repeat relative gravity surveys of networks of stations that monitor aquifer storage change. The absolute acceleration of gravity is measured twice each year at 16 stations to an accuracy of about plus or minus 2 microGal, or about a 5 cm thickness of water. Gravity variations during the period of record at the stations have ranged from 4 to 21 microGal. The greatest variations occur at stations located above aquifers where nearby water-level variations document correlative trends in aquifer storage. Gravity variation can result from non-aquifer sources including vertical displacement of the stations (around 3 μGal / cm), especially in areas of land subsidence, and variations in near-surface soil moisture. The vertical position of many of the stations, however, is monitored using the Global Positioning System and no significant variation has been detected. Gravity variations at stations located on crystalline rocks show poor correlation with soil mioisture, however, a portion of the gravity variations at stations located on alluvial soils correlate with near-surface variations in soil moisture. Removal of the soil-moisture correlation from the record at these alluvial stations decreases the variation in gravity among the stations to 14 microGal and improves the correlation of the residual gravity variations with water levels.